Water Resources Research Institute

Annual Technical Report

FY 1999

Introduction

We support and direct water research for the State of Idaho and the region. Our research results routinely lead to cutting-edge discoveries in such vital areas as water quality, water supply and water management. More importantly, these discoveries regularly lead to a greater understanding of our surroundings, offering sensible solutions toward maintaining a healthy balance between the economy and the environment.

Research Program

We support and direct water research for the State of Idaho and the region. Our research results routinely lead to cutting-edge discoveries in such vital areas as water quality, water supply and water management. More importantly, these discoveries regularly lead to a greater understanding of our surroundings, offering sensible solutions toward maintaining a healthy balance between the economy and the environment.

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Near Surface Hydrology of the Eastern Palouse Region
Project Number	1434HQ96GR02667
Start Date	09/01/1997
End Date	08/31/2000
Research Category	Ground-water Flow and Transport
Focus Category #1	Hydrology
Focus Category #2	Solute Transport
Focus Category #3	Water Quality
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
John E. Hammel	Professor	University of Idaho	01
Paul McDaniel	Associate Professor	University of Idaho	02

Problem and Research Objectives

Most soils in the eastern Palouse region of northern Idaho contain hydraulically restrictive subsurface layers such as fragipans and argillic horizons. These horizons cause percolating precipitation to perch above them in shallow water tables. These shallow perched water tables (PWTs) are present during the winter months when the majority of precipitation is received and potential evapotranspiration is minimal. Perched water tables represent a significant seasonal, near-surface aquifer throughout the region. Furthermore, because of their proximity to surface-applied agrichemicals and their ability to promote rapid, lateral water flow, PWTs may potentially impact surface water quality. The overall objective of this research is to conduct a landscape-based study of PWTs and model their impacts on subsurface-to-surface return flow and surface water quality. Specific objectives are: 1. Conduct detailed monitoring of seasonal perched water tables in a representative catchment of the region receiving 850 mm of annual precipitation; 2. Determine rates and patterns of lateral flow of perched water within the catchment, and; 3. Obtain necessary data to develop and validate models for predicting the impacts of perched water tables on local water resources in managed agricultural ecosystems.

Methodology

A 2.5-ha catchment near Troy, Idaho was selected for use in this study. The catchment has been instrumented with a a grid of 120 shallow wells and a full weather station. Within each well, a pressure transducer was placed at the interface between the hydraulically restricitve horizon and the overlying soil horizons. Transducers were calibrated to read the thickness of the perched zone of saturation and wired to dataloggers. Dataloggers were programmed to collect readings every 12 hours. In addition, a flume was installed in an ephemeral drainage channel contained within the catchment to measure surface runoff. Data collected from the catchment is being used to develop and validate a soil moisture routing model that predictis perched water table responses to climatic and landscape variables. In addition, Br- and Cl- tracers were applied in trenches on the upper part of the catchment. The direction and rate of their movment is being monitored.

Principal Findings and Significance

Using well data in conjunction with precipitation, catchment outflow, soil water content, and potential evapotranspiration (PET) data, we have been able to construct a soil water budget for the catchment. Moisture inputs from precipitation lead to a rapid increase in perched water table (PWT) height. There is a relationship between perched water table (PWT) height and the depth to the fragipan surface within the catchment – greater depth to fragipan corresponds to highere PWTs. PWTs increase and decrease rapidly in Ap, Bw, and BE horizons with less than a 5% change in volumetric soil water content. Catchment surface outflow mainly occurs between late December and early April, and represents as much as 36% of the precipitation received for 1 Nov. through May 31. Maximum catchment outflow occurs when average PWT is in the Ap horizon; outflow ceases when average PWT height drops into the less permeable E horizon. Lateral throughflow and surface outflow are the two main mechanisms by which water is lost from the catchment during the winter months. Following snow melt, evapotranspiration increases and leads to a gradual disappearance of PWTs in the catchment. Our results show that the majority of precipitation (~80%) received when PWTs are present is lost via surface runoff and lateral throughflow, thereby increasing potential for agrichemical transport and decreasing potential recharge to groundwater. Perched water tables are able to transport applied Br tracer considerable distances – we measured movement greater than 66 m over the course of a single season. Overall seasonal rates of movement are on the order of approximately 0.5-1.0 m/day. However, very rapid bypass flow can occur during periods when PWTs are in the Ap horizon – in one experiment, we were able to measure 7 m of movement of applied Br in 9 h. This again demonstrates the potential for rapid transport of agrichemicals in these PWT systems. Direction of tracer flow via PWTs is governed by the topography of the fragipan surface. The fragipan surface does not necessarily correspond to the soil surface, and this creates subsurface zones of concentrated perched water flow. Observed patterns suggest that perched water flow is not uniform across hillslopes and is extremely difficult to predict from surface features. Finally, the intensive data collection associated with this project has provided a unique opportunity to validate a soil moisture routing model developed at Cornell University. Our data demonstrate that, with adjustments for saturated hydraulic conductivity values, this model is able to accurately predict PWT levels in soils that occupy summit and upper hillslope landscape positions. However, it does a much poorer job of modeling PWT dynamics in soils occupying lower-lying landscape positions.

Descriptors

Contaminant Transport; Hydrogeology; Soil Physics; Water Quality

Articles in Refereed Scientific Journals

It is anticipated that there will be a publication at the conclusion of this project.

Book Chapters

None

Dissertations

Barndt, S.L. 2000. Tracer movement in perched water tables of an eastern Palouse catchment: implications for agricultural practices. M.S. thesis. Univ. of Idaho. Moscow. Regan, M.P. 2000. Perched water table dynamics and hydrologic processes in an eastern Palouse catchment. M.S. thesis. Univ. of Idaho. Moscow.

Water Resources Research Institute Reports

Will be published at the conclusion of the project.

Conference Proceedings

Boll, J., E.S. Brooks, C.R. Campbell, S.K. Young, J.E. Hammel, P.A. McDaniel. 1998. Progress toward development of a GIS-based water quality management tool for small rural watersheds: modification and application of a distributed model. Paper no. 982230. ASAE Annual International Meeting, Orlando, FL. ASAE, 2950 Niles Road, St. Joseph, MI. Barndt, S.L., P.A. McDaniel, J.E. Hammel, M. Regan, and A.L. Falen. 1999. Solute movement through a perched water table in the Palouse region. p. 42. In Western Soc. Soil Sci.-Pacific Div. Am. Assoc. Advance. of Science Program with abstracts. San Francisco. McDaniel, P.A., J.E. Hammel, S.K. Young, S. Rockefeller, R. Reuter, and A.L. Falen. 1998. Near-surface hydrological processes in sloping landscapes of the northwestern USA. Proceedings of 16th World Congress of Soil Science. 20-26 August, 1998. Montpellier, France. Barndt, S.L., P.A. McDaniel, J. Hammel, M. Regan, and A. Falen. 2000. Tracer movement through a perched water table on convex and concave slopes in the eastern Palouse region. p. 2 In Northwest

Scientific Assoc. 73rd Annual Meeting Program and Abstracts. March 17-18, Univ. of Idaho, Moscow. Regan, M.P., P.A. McDaniel, and E. Brooks. 2000. Perched water table dynamics of an eastern Palouse catchment basin. p. 15 In Northwest Scientific Assoc. 73rd Annual Meeting Program and Abstracts. March 17-18, Univ. of Idaho, Moscow. Regan, M.P., and P.A. McDaniel. 2000. Perched water table dynamics and hydrologic processes in an eastern Palouse catchment. p. 58 In Program with abstracts. Western Society of Soil Science Annual Meetings. Am. Soc. Advance. Sci. – Pacific Division. June 11-14, 2000. Southern Oregon University, Ashland.

Other Publications

None

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Idaho Climate Database
Project Number	1434HQ96GR02667
Start Date	03/01/1999
End Date	02/28/2001
Research Category	Climate and Hydrologic Processes
Focus Category #1	Climatological Processes
Focus Category #2	Management and Planning
Focus Category #3	Hydrology
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Myron P. Molnau	Professor	University of Idaho	01

Problem and Research Objectives

During the past several years, there has been an increasing reliance on older climate data to study a variety of problems. These range from the obvious (climate change, El Niño) to the less obvious (effect of weather variability on crop diseases, the spread of Yellow Star thistle, Salmon survival). The need for complete quality controlled data has become acute over the past years with many requests for complete datasets for analysis of El Niño effects on many aspects of the Idaho economy. The Idaho State Climate Services (ISCS) is being increasingly asked to either supply more complete datasets of better quality or to do actual analysis for some of these purposes. These data have been supplied in several forms but requests are now at least 50 percent via e-mail or the Web. Because users have come to expect data on the Web, the ISCS would like to have more data on the ISCS Web page. To have a user obtain the data they desire via the Web is very efficient since they can obtain exactly what they want without going through an intermediary. The problem with doing this is that not all the data are available in electronic form and there is a cost associated with the Web programming. The objective of this project is to develop a database of the daily Cooperative Climate Network containing all of the available daily data. This will document and preserve the data and information that will be of the most value to the state.

Methodology

The station history files were used to determine the periods that needed to be keyed. These files were jointly developed by National Climate Data Center, NOAA, (NCDC) and the Idaho State Climate Services (ISCS). These were further broken down into active and inactive stations. Active stations were those that were collecting Coop data as of summer, 1999. The emphasis on keying data was to put on the active stations first since these are the most requested data. This results in a list containing the dates when data were originally collected by each station. The second step was to compare the digital data held in three databases. These were those at NCDC, the Western Regional Climate Center, DRI (WRCC), and ISCS. It was quickly determined that the data held at NCDC and WRCC were identical while there were more data in the ISCS database than at NCDC, particularly in the 1930-1948 period. From this comparison, a table of data to be keyed for active stations was compiled. For this project, it was decided to key data from original manuscript forms wherever possible. An inventory of the forms kept at the ISCS was done. Also an inventory of data keyed from formal publications in a previous project for the period 1898-1919 was made. Because there were many missing periods for the 1898-1919 data, it was decided to key data from the manuscript forms and use other data as a quality control check. This followed the procedure used by the Utah State Climatologist and the Midwestern Regional Climate Center (MRCC) in their projects to key older data. A program developed by the MRCC was obtained and personnel trained in its use. The program output is nearly the same as the NCDC data format TD3200. This made it possible to develop fairly simple programs to reformat the keyed data into the 3200 format used by NCDC on their Web page. The reasoning behind this was that using the same format would make it easy for both ISCS and others to merge data from the two sources.

Principal Findings and Significance

At the present time, most of the emphasis in the project is being put on keying data. A great deal of difficulty was experienced in hiring a full-time key operator for the project. Several illnesses and problems with the MRCC program held back the project by several months. By hiring two part-time persons, it was possible to keep data flowing. It has also proved more difficult than originally thought to read some of the manuscript forms. In several cases, the data were simply marked as missing rather than take an inordinate amount of time on one station-month. The keying of the active station data is about 60 percent completed. Also about 15 percent of the inactive station data are also keyed. This was done both as a matter of convenience and requests by potential users. The data are checked for completeness and run through the reformatting program. All data from the ISCS is being identified as 32UI to distinguish them from the NCDC data 3200 (final daily Coop data), 3202 (preliminary daily Coop data) and 3280 (daily data derived from hourly or airport stations). Thus users will know the source of the data they are using. Rather than putting data on a CDROM as originally envisioned, it was decided to put data onto the ISCS Web page. A suitable format was developed and is being tested. A partnership with a University of Idaho Library Project titled AInside Idaho@ was formed. That project will ultimately host all of the daily data held by the ISCS. They have a much more powerful server as well as programmers who can develop excellent programs for users of the daily data. The actual data will be tested on the ISCS server but served to the public on the Inside Idaho server because the large amount of data is more than the ISCS server can handle. A Web page format for the ISCS server has been developed and is currently being tested. The format for the Inside Idaho server is now being developed but has not been tested yet. It is not possible to use the same programs to serve data on both machines because of software incompatibilities. Plans for the remainder of the project are to finish the keying of the active stations, now projected to August, 2000. The inactive station data will then be keyed in a station priority order yet to be determined. The requests for data to the ISCS will be scanned to see which inactive stations are most requested and these will be keyed in order until funds are exhausted. All ISCS data will be on an internal ISCS database by the end of August but probably will not be available to the public over the Inside Idaho until later in the year. An inventory of data already keyed and to be keyed is available and will be added to the ISCS Web site later this summer or fall when the ISCS Web site is reorganized. At that time, the station history file will also be added to the Web site so that users will know the circumstances under which the data were collected.

Descriptors

Climate; Climate History; Data Storage and Retrival

Articles in Refereed Scientific Journals

None

Book Chapters

None

Dissertations

None

Water Resources Research Institute Reports

In Progress, Anticipated Publication Date October, 2000.

Conference Proceedings

None

Other Publications

Myron Molnau, Oct, 1999, Progress report on completing the Idaho climate database. Idaho State Climate Services, University of Idaho.

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Evaluation of Recharge Mechanisms and Rates Through Loess in the Moscow-Pullman Basin Using Environmental Tracers and Soil Stratigraphy
Project Number	1434HQ96GR02667
Start Date	03/01/1999

End Date	02/28/2001
Research Category	Ground-water Flow and Transport
Focus Category #1	Agriculture
Focus Category #2	Groundwater
Focus Category #3	Water Supply
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Paul McDaniel	Associate Professor	University of Idaho	01

Problem and Research Objectives

Ground water is the principal water supply for the Moscow-Pullman Basin of eastern Washington and northern Idaho. Municipal water use by Pullman, Moscow, and the two universities has resulted in a continual decline in the regional basalt aquifer system since 1890 and a steady decrease of 1.5 ft per year in response to pumping from 1976 to 1985 (Barker, 1979). Concerns regarding this diminishing water supply have prompted development of several models that propose a wide range of recharge estimates, recharge mechanisms, and possible solutions to ensure a sustainable groundwater supply. The specific objectives of the project were to: 1. select three loessial catchments that reflect the climatic gradient across the Moscow-Pullman Basin and determine their tratigraphic and chronologic contexts; 2. determine environmental tracer (18O and Cl-) depth profiles in the loess sections at each site, and; 3. estimate modern-day and paleo-recharge of water through the loess mantle to the basalt aquifers in the oscow-Pullman Basin using loess stratigraphic and chronologic boundaries in concert with Cl- and 18O depth profiles.

Methodology

Our approach was to select three representative catchments in which to study the effect of less cover on basin hydrology across a climatic gradient. Site #1 was selected in the eastern portion of the Basin where loess is moderately deep (3-20 m), soils contain hydraulically restrictive horizons, and the climate is moist (~800 mm MAP). Site #2 was selected in the central Basin where loess is deep (~5-35 m), soils are slightly permeable, and the climate is drier (~630 mm MAP). Site #3 was selected in the western Basin where loess is very deep (~6-60 m), soils are slightly permeable, and the climate is even drier (~450 mm MAP). After representative hillslopes were selected, continuous 6-m vertical soil cores were collected at 4-6 positions within each catchment, including top, mid slope, and valley bottom. Strata was differentiated based upon soil horizon and paleosol boundaries using soil morphological field criteria, chronologic boundaries (tephra layers, & 14C dating of CaCO3), and physical properties (density, mineralogy, & texture). Cl- was extracted and analyzed on an ion chromatograph. Cl- depth profiles were constructed, and the shape of the profiles was used to interpret the response of water movement to stratigraphic boundaries. Recharge rates can be estimated using the following mass balance technique: R = (Cp x P)/Cr where R = recharge rate cm/yr Cp = [Cl-] in precipitation P = effective MAP Cr = [Cl-] in pore water The 18O signature of water will be determined through direct equilibration of soil with CO2 using a vacuum line, and measured on a mass spectrometer. 18O depth profiles will be constructed to enhance the resolution of pore water stratigraphy and supplement recharge interpretations.

Principal Findings and Significance

We have been unable to measure the 18O signature of soil water to date due to an unexpected setback in the construction of our vacuum line. We expect to begin analysis by May 2000. Cl- profiles have been measured at all sites. Sites 2 and 3, which represent deep loess in the drier portions of the Basin display uniform Cl- depth profiles indicative of strata lacking water-restrictive horizons. Minimum recharge rates ranged from 2.6 to 2.9 cm/yr. Vertical facies between soft and dense horizons coincided with sharp fluctuations in the [Cl-] of depth profiles at Site 1, which represent moderately deep loess in the moist portion of the Basin. Minimum recharge rates ranged from 0 to 0.29 cm/yr. Carbon dating of CaCO3 found in a dense layer 200-cm below the soil surface indicates that water is 10,000 cal. yr. old. The pattern of depth profiles and age of CaCO3 suggest that deep percolation of precipitation is unlikely and that water may be trapped within dense layers. In the eastern portion of the Moscow-Pullman Basin, ground water recharge rates, as inferred by Cl- depth profiles, are low because soils are well developed and contain water-restrictive horizons. In the central and western portions of the Basin, soils are more permeable, but recharge rates remain low because of less MAP and greater loess thickness. Data suggests that deep percolation of precipitation through loess hillslopes is not significant under contemporary moisture regimes.

Descriptors

Soil Groundwater Relationships; Groundwater Management; Groundwater Movement

Articles in Refereed Scientific Journals

It is anticipated that there will be a publication at the conclusion of this project.

Book Chapters

None

Dissertations

Will be published at the conclusion of the project.

Water Resources Research Institute Reports

Will be published at the conclusion of the project.

Conference Proceedings

O'Geen, A.T. and P.A. McDaniel, 1999. Soil stratigraphic influences on recharge mechanisms through

loess in northern Idaho. p.275. In. Annual Abstracts. Soil Science Soc. Am. Salt Lake City, UT. O'Geen A.T. and P.A. McDaniel, 2000. Using environmental tracers to assess soil stratigraphic influences on ground water recharge mechanisms in the Moscow- Pullman Basin. p. 13. In. Abstracts for the 73rd Annual Meeting Northwest Scientific Association. Moscow, ID.

Other Publications

None

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Phosphorus Source/Sink Dynamics in a Flood-Irrigated Agricultural System in Central Idaho
Project Number	1434HQ96GR02667
Start Date	03/01/1999
End Date	02/28/2001
Research Category	Water Quality
Focus Category #1	Agriculture
Focus Category #2	Non Point Pollution
Focus Category #3	Irrigation
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Jan Boll	Associate Professor	University of Idaho	01
Steve McGeehan	Research Associate	University of Idaho	02

Problem and Research Objectives

Water quality protection through restoration and management of watersheds is receiving tremendous attention in the United States at all levels of government and in local communities. Since contributions of most point sources (e.g., sewage treatment plants and industrial sites) have been reduced to acceptable levels, the main emphasis presently is on the control of non-point sources originating from urban, forest, agricultural, and recreational lands. Non-point sources are covered by sections 208, 303 (d) and 319 of the Clean Water Act. Approximately 1000 water bodies are currently classified as impaired or use-limited in Idaho. Many water bodies are classified as P-limited due to their high nitrogen:phosphorus ratios (N:P >> 10) (Sharpley et al., 1994; Chapra, 1997). Consequently, water pollution abatement strategies frequently focus on reductions in P loading. State and local agencies throughout the U.S. are in the process of setting permissible load allocations, expressed as Total Maximum Daily Load (TMDL), and developing water quality management plans for all use-limited water bodies. A management plan for Cascade Reservoir in central Idaho was submitted to and approved by the Environmental Protection Agency (EPA) in January of 1996. Prior to the development of this plan, water quality data were collected at different levels of comprehensiveness for forest, urban and agricultural land uses. Partitioning the total P load into the various land uses was a difficult and somewhat subjective process. In particular, P loading from agriculture, mainly flood-irrigated pasture and hay land, was not done very accurately due to limited monitoring data and the lack of representative model parameters. The agricultural P load is currently estimated to be ~15,800 kg P/yr or 44% of the annual P load to the reservoir. This value is determined from the area-weighted difference between the estimated total nonpoint load (~35,700 kg P/yr) and estimates for natural (~11,000 kg P/yr), forest (~5,900 kg P /yr) and urban sources (~3,000 kg P/yr). Clearly, better estimates of phosphorus (P) loading from agricultural land use in western states are needed. Although P loading has received considerable attention in the research literature in the past two to three decades, annual estimates of P loading from subsurface/flood or sprinkler irrigated pasture land have not been reported. Many reports available on non-irrigated pastures are mostly applicable to soils in the eastern and midwestern portions of the United States (e.g., Edwards et al. 1996; Austin et al. 1996; Beaulac and Reckhow, 1982; Loehr, 1974; Harms et al., 1974). Miller et al. (1984) reported net loss of P from flood irrigated grass and alfalfa hay land in Nevada, but measurements only covered the irrigation season, ignoring P loading during spring snowmelt. Several studies show that loading from nonpoint P sources is seasonally dependent, a fact not addressed in the current Cascade Reservoir load allocations. Given the inherent uncertainties associated with estimating nonpoint P sources, it seemed critical to pursue an improved assessment of the agricultural contribution. This study contributes to this need by documenting relationships between P loading and field parameters. It is hoped that this study will 1) provide a more accurate value for agricultural P loading in the Cascade Watershed and 2) provide information that will be transferable to other agricultural regions in the western United States. The relationships in this study are developed from direct measurement of flow volumes and soil-water P concentrations monitored throughout the year to determine seasonal P dynamics. Objectives: The overall objective of this proposal is to develop seasonal P source/sink relationships for irrigated pastures. P source/sink relationships are compared during i) spring snowmelt and rain-on-snow events, and ii) the growing season which is characterized by subsurface irrigation. Source/sink relationships are determined by measuring enrichment ratios, extraction coefficients, P desorption in soil/sediment samples and dissolved (DP), particulate (PP), and total (TP) in water samples. Specific objectives listed in first year's proposal are: Objective 1. To determine surface and sub-surface P inputs and outputs on a seasonal basis for two subsurface irrigated pasture/hay fields. Objective 2. To measure P desorption as a function of soil depth, total soil P, soil temperature and soil saturation history in the same fields as in Objective 1. Objective 3. To develop seasonal P transport relationships for dissolved and particulate P and predict annual P loading. Objective 4. To determine the dynamics of P transport beyond pasture fields in irrigation ditches. Important questions we attempt to answer are: "What are the relative magnitudes of P sources from agriculture in the Cascade Reservoir watershed ?", "What time of year do these sources release the greatest P loading?", and finally, "When is the impact of an individual source noticeable in downstream aquatic ecosystems?". Note: During Year 1, we experienced unusual weather conditions which made data collection during part of the Spring snowmelt period difficult. In order to assure meaningful results in this project, we have initiated a laboratory flume study to simulate special flow conditions observed in the field. This laboratory study will be discussed briefly in this report. Objective 2 will be achieved during the laboratory study instead of in the fields because Dr. McGeehan no longer holds a research position in the Soils Department.

Methodology

Location and Description of Study Area Geological and Hydrogeological Setting: Cascade Reservoir watershed is located in Long Valley, which is part of the mountain building Idaho batholith orogeny occurring during the Cenozoic period. The parent material consists of crystalline igneous granitic intrusive rock formations with other accessory minerals. The valley floor consists of deposits derived from the adjacent mountain with past glacial activity present in the upper portion of Long Valley. The thickness of the alluvial deposit is estimated at over 7000 feet in the north end of the watershed with the thickness decreasing as the valley trends to the south. Streams in the watershed have gradients which vary from very steep in the mountains to flat as they move towards the reservoir. Stream flow is made up of spring melt off of valley and mountain snows, storm events on snow, overland flow and base flow from ground water. Generally, two melting events occur in the watershed when the valley floor has an early melt during March -April and the higher elevation areas a late season melt in June - July (USFS, 1998). The water from the streams is diverted for land application during the summer irrigation season through a complex system of diversions, canals and laterals. Stream flow during the summer irrigation season is depleted to very low levels. Vegetation in subsurface irrigated pastures have been altered toward hydrophilic (water loving) species thereby altering vegetative water requirement and producing an artificially high water table. Because of the low flow levels and the artificially high water tables, ground water - surface water interaction is believed to occur throughout the irrigation season. Approximately 150 mm of precipitation is received during the growing season in the valleys. Ground water in the valley is present at multiple depths. Areas with extremely shallow ground water are abundant due to high input of irrigation water and shallow confining layers. Deep confined aquifers exist within the valley but have largely been undeveloped except by some municipalities. Ground and surface water are of good quality except for the existence of reduced iron oxides Fe(III) near the Donnelly-Roseberry region. Agricultural Setting: Land use within the Cascade Reservoir watershed primarily consists of forest, agriculture and urban/suburban. Steep sloping mountain ranges make up the adjoining forested land, while the flat valley floor adjacent to the reservoir is used for agriculture. Small tracts of land are used for housing development, subdivisions, villages and towns. The agricultural land uses are irrigated pasture, irrigated cropland, non-irrigated pasture and cropland, and private forest. Irrigated lands are the dominant land use type within the valley with irrigated pasture being the dominant agricultural land use. Riparian and non-irrigated pasture make up the majority of the remaining land. Dominant soils types within the valley are: Archibald, a deep well-drained strongly acidic loam formed in alluvium or glacial outwash occurring in 12% of the watershed; Donnel, a deep well-drained medium acid sandy-loam soil formed in granitic alluvium and occurring in 5% of the watershed; and Roseberry, a deep poorly-drained medium acid sandy-loam formed in alluvium or glacial outwash of granitic origin occurring in 7% of the watershed. Soil depths within the watershed are highly variable, ranging from 30 to 40 inches for Donnel and Roseberry soils and from 5 to 8 feet for Archibald soil types. Cattle are the dominant grazing animals with a small amount of sheep and horses also present. Most animals are located in the valley only during the summer grazing season which starts in early May and may run through October - November. The Study Area: The study area is located in the Boulder/Willow Creek subwatershed which drains directly into Cascade Reservoir. This subwatershed is part of the North Fork Payette River (HUC No. 17050123) in the west central portion of Valley County. Elevation at the site is approximately 4900 feet above sea level. Two pasture fields (each 18 ha) within close proximity, approximately 1.5 miles east of the town of Donnelly, Idaho, make up the study area. The valley floor has little relief (1-4%) with a general downward trending elevation from north to south. Water for the irrigation season is supplied from the Roseberry ditch, a diversion of Boulder Creek. Both pastures are subsurface irrigated at this time with controlled multiple irrigation events occurring throughout the growing season. Currently, both fields are used as cattle pastures and are irrigated using subsurface irrigation practices with one main inlet ditch and one main outlet ditch. Average temperature at this site is 5 °C, average precipitation is 584 mm, with an average of 72 frost free days. Two soil types cover the total field area: the Roseberry coarse sandy loam and the Donnel sandy loam. Roots in both soils extend to more than 150 cm. Each inlet and outlet ditch in both fields has been instrumented with flumes, automatic water samplers, and dataloggers. Flow and water sampling are event-based throughout the year. Each field also is equipped with nine groundwater wells from which groundwater levels are measured and water samples are taken monthly. Soil sampling is done before and after the irrigation season. Mr. Davidson from the Soil Conservation Commission has assisted the PI's in instrument installation, field sampling, and maintenance. The mass balance: predictive equations and parameter selection: Due to limited funds, P source/sink relationships for P loading are determined for two forms: PP and DP (see Table 1). Predictive equations have been reported in the literature and are reviewed briefly to show which parameters are to be estimated and which water quality constituents are measured in our study. These equations serve as a starting point for the data analysis. PP in runoff sediments: As soil erosion is a selective process with respect to particle size, selectivity has been observed for P loss in runoff sediments, with the result that eroded soil is usually richer in P than the surface soil from which the eroded soil comes (Sharpley, 1980). Particulate P transport, therefore, is predicted from an equation of the form (Edwards et al., 1996): PP = TSSy x Soil TP x ER (1) where PP is the (event) particulate P transport (kg/ha), TSSy is the event total suspended sediment yield (kg/ha), Soil TP is the TP content of the surface soil (kg/kg), and ER is the enrichment ratio (= PSED/Soil TP where PSED is the TP content of eroded soil). We assume that the use of TSSy for total sediment yield is reasonable for pasture land (Edwards et al., 1996). Sharpley (1980) developed a relationship between ln(ER) and ln(TSSy) as: ln (ER) = a0 + a1 x ln(TSSy) (2) where coefficients a0 and a1 appear to vary with soil and land use with approximate values of 2.2 for a0 and -0.24 for a1 representing a variety of soil and cover conditions. DP in runoff water: A general, predictive equation for DP in runoff water is as follows (Edwards et al., 1996): DP = 0.01 x D x Soil TP x XC (3) where DP is (event) soluble P transport (kg/ha), D is event runoff (mm) and XC is an extraction coefficient considered to represent the mixing of soil and runoff as well as the P desorption properties of the soil. The factor 0.01 assures consistent units. High runoff interaction and easily desorbed soil P would be reflected in an increase in XC. To develop and test above relationships for subsurface irrigated pastures, we are determining all parameters in Eqns. 1- 3 either by direct measurement or derived from measured parameters. Exceptions are a0, a1, and XC, which are determined by regression analysis. Each flume at inlet and outlet was automated so that discharge was recorded continuously. When discharge was relatively constant, the ISCO sampler obtained one full sample every 24 hours consisting of four 6-hourly composites. When discharge increased or decreased such as at the onset or end of an irrigation event, or during a storm event, the ISCO sampler obtained one full sample every hour consisting of four 15-minute composites. All samples were then collected in a timely manner, split into a filtered and unfiltered sample, treated, and transported to Dr. Boll's laboratory. Water quality samples were analyzed for TSS, TP, and DP as discussed under Analytical Methods with help of Morella Sanchez and Josh Linard. Inlet ditches were monitored only during the irrigation season, since during the non-irrigation season little flow entered the fields. Groundwater levels in piezometers in both fields were determined monthly. Each month, a groundwater sample also was collected, filtered and analyzed for DP in Dr. Boll's laboratory with help of Morella Sanchez. Total P in soil in each field was determined before and after the irrigation season. One soil sample per two acres was removed from the 0 to 5 cm depth. They were analyzed in the Analytical Science Laboratory under the supervision of Dr. McGeehan. P desorption determination: P desorption was determined on 48 soil samples taken from field 1 and 2. The procedure is explained below in Analytical Methods. Twenty-four samples were analyzed after air-drying and 24 samples were analyzed at field-moisture content. Seasonal P transport relationships and annual P loading: PP was determined as the difference between TP and DP. ER was calculated as the ratio of PP in eroded soil to TP in soil samples. The parameters a0 and a1 in Eqn. 2 then were determined by applying simple linear regression to TSS and ER. Values for XC in Eqn. 3 were determined from measured data of D, Soil TP and DP in runoff water. Annual TP loading (mg P ha-1 yr-1) was estimated using measured TP in runoff water and the discharge measurements. The dynamics of P transport beyond pasture fields in irrigation ditches: Six locations were selected for ditch sampling: locations #1 and #2 were before the inlet to field 2, locations #3 and #4 were the inlet and outlet of field 2, respectively, and locations #5 and #6 were after the outlet of field 2. The established flow path connected Roseberry Ditch to Willow Creek. Measurements at each location included the determination of flow rate and P concentrations during one irrigation event on September 7, 1999. Each location was visited twice. Unfortunately, irrigation was ceased for the year afterwards and natural events have not occurred since. Two of Dr. Boll's graduate students and Mr. Davidson performed the sampling. Flow rates in irrigation ditches were determined as the product of cross-sectional area (m2) and velocity (m/s). Flow velocity (v) was determined using a portable current meters using the Velocity-Area method. During each visit, a sample for P determination was collected using depth-integrated sampling procedures outlined in Edwards and Glysson (1988). Where waters were of sufficient depth, the US-DH48 depth integrated sampler was used. For shallow waters, grab samples were taken at different locations in the cross-section. During this first sampling event, ditch sediments and vegatation samples were not collected. Laboratory flume study: During Spring of Year 1 (1999), we experienced severe flooding of the fields forcing us to take out all instrumentation. During the Fall of Year 1 (1999), weather conditions did not cause runoff events. To assure data collection for specific field conditions while controlling environmental conditions, we have initiated a laboratory flume study. This laboratory study has not produced results, but the design is discussed here briefly. The objectives of the flume study in essence are the same as for the field study. However, objective 2 was eliminated for the field study but is included in the laboratory study. P mobilization and transport parameters will be determined in triplicate in aluminum flumes 1 m long, 0.2 m deep, and 3x0.1 m wide. Soils from field 1 and 2 were collected on October 10, 1999 including the undisturbed surface sod layer. Soil will be packed in the flumes to the same bulk density as in the field sites. Subsurface flow, surface flow and rainfall will be simulated followed by event-based sample collection. P sorption/desorption capacity will be related to soil redox potential and concentration of dissolved metals to better explain chemical mechanisms controlling P mobilization. If time permits, vertical P movement in the flumes will be measured. These experiments will be performed by Morella Sanchez to fulfill the requirements of her Ph.D. dissertation. Analytical methods: Phosphorus fractionation of water samples followed the methods of Sharpley (1993). TP was determined on unfiltered samples following four-acid digestion (EPA Method 3050). DP was determined on filtered (0.45 mm) samples. DP is assumed to consist mostly of ortho-phosphate (Sharpley et al., 1994). PP was calculated as the difference between TP and DP. Soil TP was determined using EPA Method 3050. P desorption profiles were determined using a 10-cycle sequential technique described by Oloya and Logan (1980). Cumulative desorbed P was calculated from the total P released from each sample through 10 desorption cycles. TSS (Total Suspended Solids) were determined by filtering a well-mixed sample through a weighed standard glass-fiber filter (0.4 mm) and drying the residue retained on the filter to a constant weight at 103 to 105°C (Method 2540 D in APHA, 1995). The phosphorus concentration in the various fractions of water and desorption equilibrium solutions was quantified using the ammonium molybdate method (EPA Method 365.2) in Dr. Boll's laboratory with the help of Morella Sanchez and one undergraduate student trained through this project. Soil TP was determined by ICP spectroscopy at the University of Idaho Analytical Sciences Laboratory. Standard Quality Assurance procedures were followed as outlined in the Standard Methods for the Examination of Water and Waste Water (APHA, 1995) and Standard Methods of Soil Analysis (Klestra and Bartz, 1996). All sampling and analytical procedures followed written Standard Operating Procedures. Water samples, except those for TP analysis, were filtered on site prior to transport. To address field soil variability, a series of subsamples were collected and thoroughly mixed to form a composite sample. Chemical analysis of the samples followed Good Laboratory Practices regarding sample storage, timeliness of analysis, analytical precision and accuracy, data collection and record keeping. Each analytical batch included 10% quality control samples such as duplicates, spikes, and reagent and field blanks. Determination of DP in water samples took place within 48 hours of collection and filtration in the field. TP was preserved at pH<2 using H_2SO_4 and analyzed within 24 days.

Principal Findings and Significance

The majority of our findings are based on data from the summer 1998 irrigation season. Unusual cold weather conditions in December, 1998, followed by a large snow pack resulted in a frozen ground and large amounts of meltwaters in March/April of 1999. All electronic equipment had to be removed during that time leaving only some qualitative sampling for the Spring Season. We show and discuss: example data for inlet and outlet of field 1 and 2, general range of concentrations of different P fractions, P desorption data, preliminary ER and XC coefficients, preliminary export coefficients(kg/ha), source/sink dynamics, and sampling data from the flow path including ditches before and after field 2. Observations from flow rate and dissolved P concentrations versus time for inlet and outlet are of interest. First, the flow rates at the inlet are much greater than at the outlet. Second, the step-wise changes in flow rate at the inlet are smoothed dramatically at the outlet. Third, the P concentrations at the inlet are lower than at the outlet. Range of concentrations Phosphorus concentrations in ground water were on the order of 0.1 mg/L or less. DP concentrations in surface water ranged from 0.01 to 0.05 mg/L at the field inlet and 0.07 to 1.41 mg/L at the field outlet. TP concentrations in surface water range from 0.03 to 1.47 mg/L and 0.26 to 1.2 mg/L at inlet and outlet, respectively. According to Sallade and Sims (1997) some of our measured concentrations are higher than concentrations associated with surface water eutrophication (0.02 mg/L). Suspended sediment concentrations were low, and, as a result, particulate P was low as well. Important observations during the Spring snowmelt show that oxygen concentrations in the field soil and ditch waters reduced to near zero clearly identified by the characteristic smell associated with anaerobic conditions. TP concentrations were on the order of 1 ppm during this time period. These measured concentrations again are higher than concentrations associated with surface water eutrophication (0.02 mg/L). P desorption P desorption data indicate that these soils are capable of contributing up to 0.2 mg P/L to the soil solution. This concentration is consistent with outflow P values measured during events summer 1999 irrigation events. Although other sources of P must be considered, this observation suggests that soil P desorption can be a significant source of outflow P on a seasonal basis. ER and XC coefficients The enrichment ratio (ER) calculated during the irrigation season, where PP = TP - DP. ER values obtained compare reasonably well with those reported by Edwards et al. (1996). Equation (2) was applied to obtain values of a0 and a1, but due to limited analysis of outlet data at the present time, these values do not compare well with typical values a0 = 2.2 and a1 = -0.24 reported in the literature. Eqn. (3) was used to obtain extraction coefficients for a few events during the irrigation season according to Edwards et al. (1996). High runoff interaction and easily desorbed soil P would be reflected in an increase in XC. XC was calculated for 3 periods during the 1999 irrigation events in the inlet and outlet of Field 1. Typical XC values by Edwards et al. (1996) ranged from 0.03 to 0.08 with a few extreme values of 0.19, 0.29, and 0.82 after poultry application. The XC values from the two pasture fields are lower than values reported by Edwards et al. (1996). Further analysis on ER and XC will be performed by Josh Linard as part of a Senior Capstone Course (EnvS 497) in the Environmental Science Program at UI. Export coefficients Export coefficients calculated from FY1999 data range from 0.105 kg/ha during the 1999 irrigation season to 0.473 kg/ha during late spring (April 20/May 19, 1999). These estimates are very preliminary. Source/sink dynamics It is important to point out that, while DP and TP concentrations increased from inlet to outlet during the irrigation season, DP loading on average increased from 2 g/day/ha to 8 g/day/ha and TP loading on average decreased from 27 g/day/ha to 12 g/day/ha. In other words, both fields acted as sinks to total phosphorus during the summer of 1999. Obviously, the sink effect is due to relatively low water flow volumes leaving each field. It is also interesting that one large event in November 1998 produced much greater P loading than events during the irrigation season. These data indicate the need for continued attention to loading estimations, and to explore the mechanisms causing P source/sink dynamics. Data from flow path along ditches In the experiment conducted during subsurface irrigation on September 7, 1999, we tracked DP and TP in paired locations along a short flow pathway in the irrigation ditch leading to field 2, through field 2, and on to the ditch leading away from field 2. We found that the loading of DP consistently decreased in the ditches and increased in field 2. Total P increased in the first ditch and decreased in field 2 and the second ditch. A mass balance on these data could not be performed because the flow rate data were not consistent. The flow rate reading for location #3 appears erroneous while at locations #5 and #6 additional water from an adjacent field entered the irrigation ditch. REFERENCES APHA (American Public Health Association). 1995. Standard methods for the examination of water and waste water. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D.C. 19th edition. 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An innovative approach to estimate bioavailable phosphorus in agricultural runoff using iron-oxide impregnated paper. J. Environ. Qual. 22:597-601. Sharpley, A.N., S.C. Chapra, R. Wedepohl, J.T. Sims, T.C. Daniel, and K.R. Reddy. 1994. Managing agricultural phosphorus for protection of surface waters: Issues and options. J. Environ. Qual. 23(437-451.

Descriptors

Agriculture; Phosphorus; Irrigation

Articles in Refereed Scientific Journals

It is anticipated that there will be a publication at the conclusion of this project.

Book Chapters

None

Dissertations

Will be published at the conclusion of the project.

Water Resources Research Institute Reports

Will be published at the conclusion of the project.

Conference Proceedings

Davidson, D, J Boll, S.L. McGeehan. 1999. Assessing BMP Effectiveness in Reducing Phosphorus Loading in Irrigated Pastures. "Water Quality – Beyond 2000", Boise, ID, Jan 27-29, 1999.

Other Publications

Information Transfer Program

A vital component in the institute's mandate is to distribute its research results to the general public. In addition to formal research reports published in technical journals, our scientists regularly publish results and make presentations designed for a lay audience. We sponsor a range of timely conferences and short-courses and produce audio-visual materials including educational videos. Education workshops such as Idaho Streamwalk, Project WET and EMPower are listed as conference projects under Information Transfer.

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Project WET (Water Education for Teachers)
Description	K-12 Teacher Education Program for Water Education
Start Date	03/01/1999
End Date	02/28/2000
Type	Conferences
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Leland L. Mink	Professor	Water Resources Research Institute	01
Julie Scanlin	Professional Staff	Water Resources Research Institute	02

Problem and Research Objectives

Project WET (Water Education for Teachers), Idaho, an interdisciplinary, supplementary water education program for Idaho educators, was established this past year. The goal of Project WET is the facilitate and promote an awareness, appreciation, and understanding of Idaho's water resources through the development and dissemination of classroom-ready teaching aids. Like other successful natural resource education programs, Project WET emphasizes teaching students how to think, not what to think.

Methodology

There were 23 workshops conducted throughout Idaho. Two-day and three-day sessions were conducted for teachers both in-class and in the field. Classes have 20-30 teachers participating.

Principal Findings and Significance

Approximatly 500 teachers were trained this past year. Some of these teachers were participating in the program for the second time.

Articles in Refereed Scientific Journals

None

Book Chapters

None

Dissertations

None

Water Resources Research Institute Reports

None

Conference Proceedings

None

Other Publications

None

Basic Project Information

Basic Project Information	
Category	**Data**
Title	EM Power
Description	A Waste Managment Youth Education Curriculum
Start Date	03/01/1999
End Date	02/28/2000
Type	Conferences

Type	Conferences
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Leland L. Mink	Professor	Water Resources Research Institute	01

Problem and Research Objectives

EM*Power is a Waste Management youth education program. The 4-H youth component curriculum is well rounded so that youth can be taught "how to think, not what to think" in relation to waste management. This provides 4-H youth with hands-on activities to gather factual information, make informed decisions and develop creative solutions in the realm of waste management.

Methodology

EM Power workshops were conducted at three different conferences and workshops regionally and nationally. The EMPower curriculum is currently being revised and will be submitted to a national 4-H jury review this fall. The curriculum also has gone through an evaluation process that included professional staff and faculty from four different universities across the country this past spring. Recommendations from this evaluation are being implemented into the revised curriculum.

Principal Findings and Significance

Approximately 450 participants were involved in three different workshops and conferences.

Articles in Refereed Scientific Journals

None

Book Chapters

None

Dissertations

None

Water Resources Research Institute Reports

None

Conference Proceedings

None

Other Publications

None

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Idaho Streamwalk
Description	Adult Education Curriculum detailing physical, biological and chemical characterization of streams
Start Date	03/01/1999
End Date	02/28/2000
Type	Conferences
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Leland L. Mink	Professor	Water Resources Research Institute	01
Peggy J. Hammel	Professional Staff	Water Resources Research Institute	02

Problem and Research Objectives

Idaho Streamwalk, a citizen volunteer monitoring program, also contributes strength to the IWRRI's outreach program. This program, coordinated through the Institute, was designed by the Environmental Protection Agency, Region 10. The goals of Streamwalk are to encourage citizen commitment to protecting streams, educate people about the relationship between streams and the watersheds, equip individuals with a screening tool to identify potential problem areas, provide a standardized data collection method so regional and trend comparisons can be made, and focus experts' limited resources on suspected problem areas.

Methodology

Idaho Streamwalk was presented at the Boise River Festival. It was also presented at one national meeting and was used as an add-on to the Project WET workshops.

Principal Findings and Significance

Approximately 200,000 people attend the festival annually. It was also presented as an add-on to 23 Project WET workshops. Athe the national meeting approximately 30 people attended the Idaho Streamwalk course.

Articles in Refereed Scientific Journals

None

Book Chapters

None

Dissertations

None

Water Resources Research Institute Reports

None

Conference Proceedings

None

Other Publications

None

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Connections 99:colon; Idaho Ground Water Workshop
Description	A conference which addresses ground water issues in Idaho and the Northwest region.
Start Date	09/27/1999
End Date	09/28/1999
Type	Conferences
Lead Institution	Water Resources Research Institute

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Leland L. Mink	Professor	Water Resources Research Institute	01
Peggy J. Hammel	Professional Staff	Water Resources Research Institute	02

Problem and Research Objectives

This conference is held every two years. We have been conducting this conference over an eight year period. Many agencies, businesses and companies assist in the coordination and implementation of this workshop. They include: Anderson Associates, CH2M Hill, City of Boise, Idaho Bureau of Laboratories, Idaho Department of Water Resources, Idaho Department of Environmental Quality, Idaho Engineering & Geology, Inc., Idaho Environmental Forum, Idaho Water Resources Research Institute, UI, IDEXX Laboratories, Maxim Technologies, Micron Technology, Inc., Montgomery Watson, Scanlan Engineering, Western Farm Service, Inc., USDI Bureau of Reclamation and United States Geological Survey. The purpose of this conference is to being ground water professionals together to share their research and education efforts in their communities. In addition to the conference we conduct an average of five workshops which address technical training and research in the area of ground water. Please see program.

Methodology

PROGRAM Day One - Monday, September 27, 1999 7:00 am Registration 8:00 - 8:15 am Welcome (The Summit): Gerry Winter, Idaho Division of Environmental Quality, Boise, ID 8:15 - 9:30 am Keynotes (The Summit): Steve Allred, Administrator, Idaho Division of Environmental Quality, Boise, ID, and Karl Dreher, Director, Idaho Department of Water Resources, Boise, ID 9:30 - 10:00 am Break, Poster Session & Exhibitors (The Glen) 10:00 - 11:30 pm Session 1A (Salmon River), Conjunctive Use - Ground Water/Surface Water Moderator: Gary Johnson, UI, Idaho Falls, ID Preliminary Recommendations for Designating Conjunctive Management Units in Idaho - Gerald Sehlke, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID Ground Water Modeling of the South Park Conjunctive Use Project, Park County, Colorado - Harvey S. Eastman, Jehn Water Consultants, Inc., Denver, CO Idaho Ground Water Response Zones - Hal Anderson, Robert Sutter, John Lindgren, Idaho Department of Water Resources, Boise, ID Use of Response Functions in Development of Mitigation Plans for Ground Water/Surface Water Interference in the Eastern Snake River Plain, Idaho - Donna M. Cosgrove, Gary S. Johnson, Idaho Water Resources Research Institute, Idaho Falls, ID 10:00 - 11:30 pm Session 1B (The Summit), Ground Water Hydraulics Moderator: Gerry Winter, Division of Environmental Quality, Boise, ID Boise Hydrogeophysical Research Site: Overview and Initial Results - Warren Barrash, Tom Clemo, Michael Knoll, Boise State University, Boise, ID Laboratory Determination of Porosity, Hydraulic Conductivity, and Diffusivity for Basalt Cores - Allan Wylie, Rodger Jensen, Gary Johnson, Idaho Water Resources Research Institute, Idaho Falls, ID Seismic Reflection Characterization of Hydrostratigraphic Facies in the Boise Valley - Lee Liberty, Spencer Wood, Boise State University, Boise, ID A Ground Water Investigation to Determine if there is Interference Between a Well and Springs on Eightmile Creek, Wasco County, Oregon - Marc Norton, Oregon Water Resources Department, Salem, OR 11:30 - 1:00 pm Lunch (on your own) 1:00 - 2:30 pm Session 2A (Salmon River), Conjunctive Use, continued Moderator: Christian Petrich, Idaho Water Resources Research Institute, Boise, ID Managed Aquifer Recharge Investigations in the Eastern Snake River Plain - Paul Castelin, Idaho Department of Water Resources, Boise, ID and Robert Schmidt, Bureau of Reclamation, Boise, ID Investigation of Ground Water/Surface Water Interactions in the Thousand Springs, Idaho Area - Laura Janczak, Rodger Jensen, Gary Johnson, Donna Cosgrove, Idaho Water Resources Research Institute, Idaho Falls, ID Surface Water/Ground Water Interaction Near the New York Canal, Lower Boise River Basin - Rick Carlson, Idaho Department of Water Resources, Boise, ID and Christian R. Petrich, Jon J. Hutchings, Idaho Water Resources Research Institute, Boise, ID. Site-Specific Implementation of Conjunctive Management Utilizing a Location in the Boise River Basin - David R. Tuthill, Idaho Department of

Water Resources, Boise, ID 1:00 - 2:30 pm Session 2B (The Summit), Ground Water Hydraulics, continued Moderator: Chuck Feast, CH2M Hill, Boise, ID Installation of a Geothermal Injection Well in the Boise Geothermal Aquifer - Patrick Naylor, Montgomery Watson Engineers, Boise, ID Determination of Ground water Flow Direction and Vertical Hydraulic Gradient in a Density-Variant Aquifer - Tong Li, Li Yong, Michelle Simon, Ben Hough, Tetra Tech EM, Inc., Seattle, WA Correlation of Tidal Influence Analysis to Controlled River or Reservoir Stage Influence on Ground Water Levels - Li Yong, Tong Li, Michelle Simon, Ben Hough, Tetra Tech EM, Inc., Seattle, WA Water Level Response in a Deep Unconfined Aquifer Using the Isobaric Well Completion - J. Hubbell, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID and Allan Wylie, Idaho Water Resources Research Institute, Idaho Falls, ID 3:00 - 4:30 pm Session 3A (Salmon River), Ground Water Monitoring Moderator: Janet Crockett, Idaho Department of Water Resources, Boise, ID Implementation of a Regional Agrichemical Ground Water Monitoring Program in Idaho - Gary Bahr, Idaho State Department of Agriculture, Boise, ID Vadose Zone Monitoring: A Management Tool to Protect Ground Water at Land Application Sites - George Spinner, Cascade Earth Sciences, Pocatello, ID Use of Stable and Radioactive Isotopes in Regional/Local Ground Water Monitoring - Bruce Wicherski, Ed Hagan, Rob Howarth, Dave Schwarz, Dean Yashan, Idaho Division of Environmental Quality, Boise, ID Assessment of Sources of Elevated Nitrate in Ground Water in Northwest Ada County, Idaho, Using Environmental Isotopes, Rob Howarth, Idaho Division of Environmental Quality, Boise, ID 3:00 - 4:30 pm Session 3B (The Summit), Conceptual, Numerical and Geochemical Modeling Moderator: Donna Cosgrove, Idaho Water Resources Research Institute, Idaho Falls, ID The Importance of Scale in Site Conceptual Model Development for a Fractured Rock Aquifer - John Bukowski, Lance Peterson, Kent Sorenson, Jr., Lockheed Martin Idaho Technologies, Idaho Falls, ID Calibration of the Treasure Valley Ground Water Flow Model Using Automated Parameter Estimation - Christian Petrich and Jon Hutchings, Idaho Water Resources Research Institute, Boise, ID and Scott Urban, Idaho Department of Water Resources, Boise, ID A Geochemical Model of Regional Ground Water Flow in the Central Treasure Valley - Jon Hutchings, Christian Petrich, Idaho Water Resources Research Institute, Boise, ID, Kent Keller, Washington State University, Pullman, WA, and Spencer Wood, Boise State University, Boise, ID Treasure Valley Domestic, Commercial, Municipal, and Industrial (DCMI) Water Needs Assessment - Scott Urban, Zena Cook, Hal Anderson, Idaho Department of Water Resources, Boise, ID and Molly Maupin, United States Geological Survey, Boise, ID 4:30 - 6:00 pm Connections '99 Recharge-Social Time, Posters & Exhibitors (The Glen) Day Two - Tuesday, September 28, 1999 8:30 - 10:00 am Session 4 (The Summit), Community Solutions Moderator: Ken Neely, Idaho Department of Water Resources, Boise, ID The Ground Water Guardian Program - Cathy Chertudi, City of Boise, Boise, ID Involving the Public - Phil Cohen, City of Redmond, Redmond, WA Community Problem Solving - Barbara Jewell, Idaho Division o Environmental Quality, Idaho Falls, ID and James Rush, Rocky Mountain Environmental Associates, Inc., Idaho Falls, ID Implementation of the Agricultural Ground Water Protection Program for Idaho - Gary Bahr, Idaho State Department of Agriculture, Boise, ID 10:00 - 10:30 am Break (The Glen) 10:30 - 11:30 pm Session 5A (Salmon River), Remediation Moderator: Paul Spiller, Maxim Technologies, Boise, ID Bioremediation of Contaminated Ground and Surface Water - Joseph Harrington, Greenworld Science, Inc., Moscow, ID and Keith Prisbrey, University of Idaho, Moscow, ID Coeur d'Alene River Sediment InSitu Treatment Technology Demonstrations - Leland "Roy" Mink, Barbara Williams, Idaho Water Resources Research Institute, Moscow, ID, and Steve McGeehan, University of Idaho, Moscow, ID The Midnite Mine - Barbara Williams, Idaho Water Resources Research Institute, Moscow, ID 10:30 - 11:30 pm Session 5B (Payette River), Conceptual, Numerical and Geochemical Modeling,continued Moderator: John Welhan, Idaho Geological Survey, Pocatello, ID A Stochastic Model for the Simulation Contaminant Transport in the Snake River Plain Aquifer - Edith Gego, Gary Johnson, Idaho Water Resources Research Institute, Idaho Falls, ID and John Welhan, Idaho Geological Survey, Pocatello, ID Construction of a Hydrostratigraphic Model for the Snake River - Charles Neal Farmer, National Park Service, Hagerman, ID Nitrogen Mineralization: Its Implication on

Water Quality - Mir-M Seyedbagheri, Elmore County Extension, Mountain Home, ID 11:30 - 1:00 pm Luncheon (The Glen) Speaker: R. David G. Pyne, Director of ASR Systems, CH2M Hill, Gainesville, FL, Aquifer Recharge: Challenges and Opportunities 1:00 - 1:30 pm Closing Remarks (The Glen) Leland "Roy" Mink, Director, Idaho Water Resources Research Institute, University of Idaho 1:30 - 3:30 pm Session 6, Short Courses A—(Payette River) Statistical Methods for Ground Water Quality Analyses - Can We Talk??? - Ken Neely, Idaho Department of Water Resources, Boise, ID B—(Snake River) Demonstration of Proper Techniques of Ground Water Well Micro-Purging - David Lee, YSI, Inc., Elk Grove, CA C—(Salmon River) Enhanced In Situ Bioremediation of Chlorinated Solvents Through Reductive Dechlorination, Kent Sorenson, Jr., Lance Peterson, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID, and Roger Ely, University of Idaho, Moscow, ID D—(Willows) Idaho Risk Based Corrective Action for Petroleum Releases: the Marriage of LUST and RBCA Three Years Later; the Honeymoon continues? An Overview and Description of Proposed Revisions - Bruce Wicherski, Jeff Fromm, Idaho Division of Environmental Quality, Boise, ID

Principal Findings and Significance

We believe this effort has been very successful. Our registration was over 300 this past conference year and has been as high as 400 in previous years. We have found that the opportunity to bring ground water professionals together has proven to be very successful and it provides an opportunity to share cutting edge research in the state and in the region.

Articles in Refereed Scientific Journals

None

Book Chapters

None

Dissertations

None

Water Resources Research Institute Reports

None

Conference Proceedings

None

Other Publications

A publication of abstracts of each of the presentations was published and disseminated at the conference.

USGS Internship Program

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 RCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	0	0	0	0	0
Masters	3	3	0	0	6
Ph.D.	0	0	0	0	0
Post-Doc.	0	0	0	0	0
Total	3	3	0	0	6

Awards & Achievements

An extensive Idaho State Climate historical database will be published in the fall of this year. The purpose of which will be to provide a daily Cooperative Climate Network to serve Idaho.

Publications from Prior Projects

Articles in Refereed Scientific Journals

None

Book Chapters

None

Dissertations

None

Water Resources Research Institute Reports

None

Conference Proceedings

None

Other Publications

None